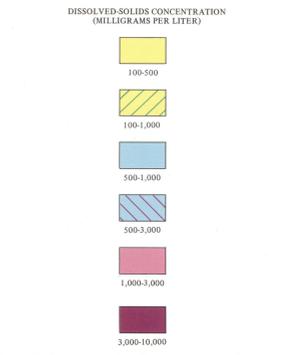


EXPLANATION
The concentration of dissolved solids in water from most springs and water wells should be within the ranges shown. More detailed information about the chemical quality of ground water is obtainable from the U.S. Geological Survey, Salt Lake City, Utah.



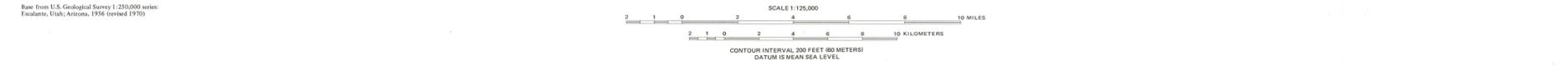
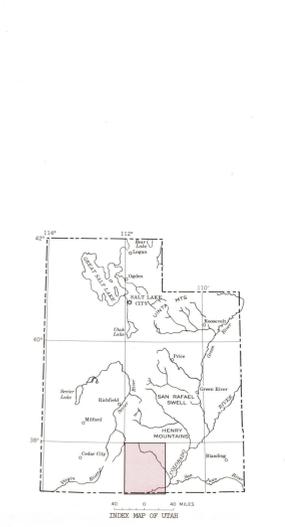
INTRODUCTION
This is one of a series of maps that describe the geology and related natural resources in the Kaiparowits coal-basin area. Chemical analyses of water from about 40 widely scattered springs, 20 coal-exploration holes on the Kaiparowits Plateau, and 7 water wells in the vicinity of the communities of Escalante and Glen Canyon were used to compile this map. All the water samples were from depths of less than 1,000 feet (305 m). Water-quality data were also available from a number of petroleum wells and exploration holes more than 5,000 feet (1,524 m) deep; however, those data were used with considerable discretion because water produced by deep petroleum wells and exploration holes usually is more saline than water found at shallower depths at the drilling sites.
Most of the chemical analyses used were collected by the U.S. Geological Survey in cooperation with State, local, and other Federal agencies. Published sources of data included Phoenix (1963), Iorns, Hentzen, and Phoenix (1964), Cooley (1965), Felts (1966), and Goode (1966, 1969), and the Environmental Impact Statement of the proposed Kaiparowits power project (U.S. Bureau of Land Management, 1976). Little or no ground-water-quality data were available for large areas in the Kaiparowits coal basin. In these areas, the indicated ranges of dissolved-solids concentrations in water from springs and wells are inferred largely from the geology as compiled by Stokes (1964) and Heckman and Wyatt (1973). This is especially true for those areas where the designated ranges of dissolved-solids concentrations are 100,000 and 500,000 mg/l (milligrams per liter).
El Paso Natural Gas Co., Resources Co., Kaiser Engineers, and Southern California Edison Co. provided ground-water samples and specific water-quality data collected from their exploratory drill holes on the Kaiparowits Plateau. The cooperation of those firms is gratefully acknowledged.

QUALITY OF GROUND WATER
Ground water in most parts of the Kaiparowits coal-basin area ranges from fresh to slightly saline, according to the following water-quality classification used by the Geological Survey (Hem, 1970, p. 219):

CLASS	(MILLIGRAMS PER LITER)
Fresh	0-1,000
Slightly saline	1,000-3,000
Moderately saline	3,000-10,000
Very saline	10,000-35,000
More than 35,000	More than 35,000

In general, the fresh waters are of the calcium bicarbonate type, and the saline water are of the sodium sulfate type. However, sodium was found to be a major cation and sulfate a major anion in some of the freshwater samples, and bicarbonate was found to be a major anion in several of the more saline waters sampled. Chloride is apparently a minor constituent in even the most highly saline waters sampled (except in saline waters from deep petroleum wells and exploration holes).
The available chemical analyses indicate that the ground water is generally freshest throughout the headwater areas of the Escalante River, along Cottonwood and Hackberry Canyons, and in the immediate vicinity of Lake Powell. In these areas, the springs sampled commonly contained less than 500 mg/l of dissolved solids.
The ground water is generally most highly saline along the southern margin of the Kaiparowits Plateau and in the northeast corner of the map area. Seeps sampled May 29 and 31, 1976, in the lower reaches of Warm and Last Chance Creeks contained 4,710 and 3,520 mg/l of dissolved solids, respectively. Field measurements of the specific conductance of water from seeps in lower Tibet Canyon also indicate the water to be at least slightly saline. The chemical quality of ground water within the Kaiparowits Plateau apparently is highly variable, generally ranging from fresh to slightly saline. The dissolved-solids concentration in water samples from several coal-exploration holes drilled within a 2-square-mile (5-km²) area (in T. 41 S., R. 3 E.) ranged from less than 500 mg/l to more than 1,500 mg/l. A similar large variability in ground-water quality probably also exists in the northeast part of the map area, where rocks of variable lithologic composition are exposed.
With regard to geologic source, ground water in the Navajo Sandstone is consistently of good quality throughout the Kaiparowits coal-basin area. Most of the freshwater springs along Cottonwood and Hackberry Canyons and in the immediate vicinity of Lake Powell discharge from the Navajo. Base flow of streams that drain the Navajo north of the Escalante River is also fresh, indicating that water from the Navajo in that general area is also fresh. Several wells that tap the Navajo in the vicinity of the community of Glen Canyon produce water containing about 500 mg/l to slightly more than 1,000 mg/l of dissolved solids. Based on all available data (including chemical analyses of base flows at the mouths of Walweep, Warm, and Last Chance Creeks prior to filling of Lake Powell), it is assumed that the Navajo, even where deeply buried beneath younger rocks in the Kaiparowits Plateau, contains freshwater, with local pockets of slightly saline water.
The most highly saline ground water in the Kaiparowits coal-basin area is in the Tropic Shale, which is exposed around the margins of the Kaiparowits Plateau, and the Mancos Shale, which is exposed in the northeast corner of the map area. In these areas, it may be possible to obtain better quality ground water from wells drilled to and tapping underlying sandstone strata (including the Navajo Sandstone). However, this may require drilling to depths of several thousand feet.

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**MAP SHOWING GENERAL CHEMICAL QUALITY OF GROUND WATER
IN THE KAIPAROWITS COAL-BASIN AREA, UTAH**

By
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1977